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SOURCE

1. The USSR has developed the following two semi-automatic welding machines:

   (a) Semi-automatic, hose-type welding machine,

   (b) Semi-automatic, hose-type PSh-5 which is used in ship repair and ship construction.

The PSh-5 is a semi-automatic, hose-type welding machine intended for semi-automatic welding under a flux coat. This apparatus and another welding semi-automatic machine, PDSh-500, were developed and designed in 1949 by engineers and scientific workers of the Institute of Electro-welding i/n Academician Paton. The designers received the Stalin Prize for the semi-automatic PDSh-500 and PD-5. Essentials of use and principles of construction of the PSh-5 are as follows: Automatic are-welding under a flux coat has become very wide-spread in Soviet ship construction and ship-repair. The usual schematic arrangement of automatic welding is represented as follows. The electrode wire (1) is fed from a spool (2) into the area to be welded by an automatic head (3). Flux (6) is fed from the hopper (5) along the tube (4). The unused flux residue is sucked out into the hopper. (slag crust, (8) remains behind the sucked-out flux residue and is broken off). Usually synthetically extracted silicates in granular form are used as a flux.

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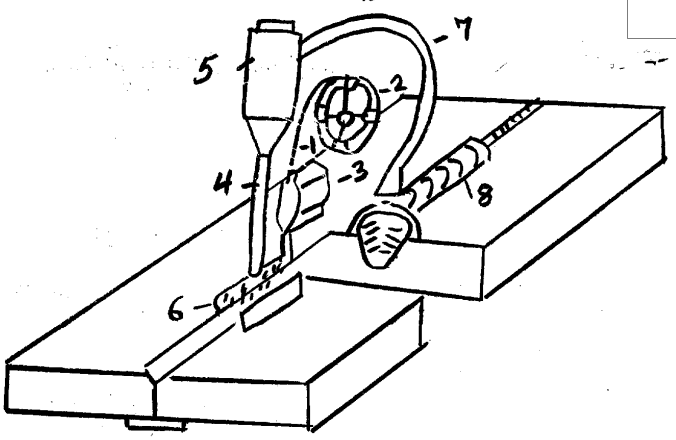


2. The advantage of this method as compared with automatic, open-arc welding lies first and foremost in the fact that the arc burns inside a gas bubble, formed by vaporized metal and molten flux, which, like high grade electrode coating, during open-arc welding forms a shield of molten metal against the harmful action of atmospheric gases (nitrogen and oxygen) and improves the chemical composition of the metal to be welded. However, the principal advantage of welding under a flux coat lies in the use of high current (up to 3000-4000 A /amperes/. This increases welding efficiency without detriment to welding quality.

3. The use of a stepped-up current (higher than 400-500 A /amperes/) in open arc-welding does not insure a good quality weld due to greater mechanical pressures of arc gasses on the surface of the crater /vanna/ of molten metal. The weld obtained is diffuse, "jogged" with unequally deposited layers, incrustations, spatterings and congealed drops of the electrode metal.

4. Immersion of the welding arc under a coat of flux has made it possible to use a higher current and to obtain high-quality welds because of the pressure of the flux layer on the molten metal crater /vanna/ assures proper formation of the weld even when the strength of the current is 3000-4000 A /amperes/. Since the arc is enclosed in a flux-sealed bubble /pustyr'/, metal losses through combustion and spattering are almost entirely eliminated.

5. Increasing the strength of the current has made flux-coat welding five to 10 times or more efficient than automatic open-arc welding and 15 to 20 times more efficient than hand-welding.

   This increase in welding efficiency is achieved by:

   (a) Using higher currents,

   (b) Increasing the speed of welding,

   (c) Reducing the amount of metal fused-on (when welding sheets up 25 mm thick without grooving the joint edges /RAZDELKA KROMOK/ and reducing the angle of grooving /UGOL RAZDELKI/ when welding sheets of greater thickness),

   (d) Absence of electrode material losses due to combustion and spattering.

6. Since welding under a flux coat is carried on with bare electrodes, expensive electrodes with thick high-grade coatings need not be used.

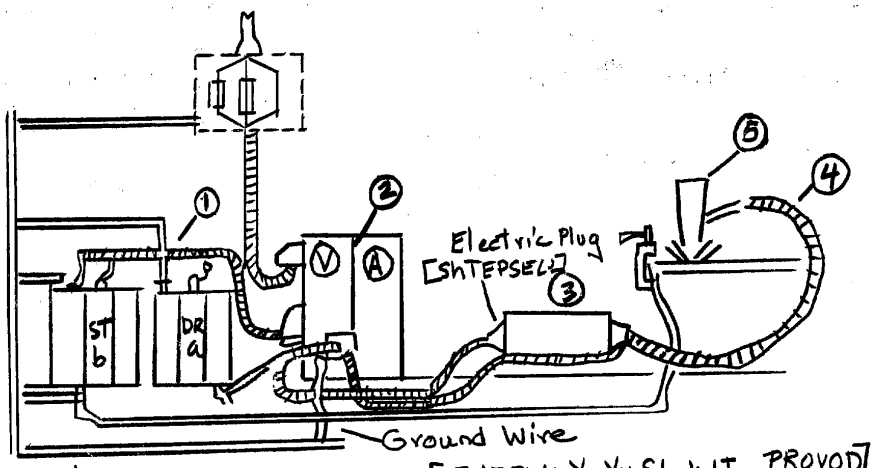
7. However, automatic welding under a flux coat can be used only on straight line welds or welds which describe the arc of a circle, and in those positions where the flux can be retained and where no changes in the welding regime are required. Automatic weldings cannot be used for zig-zag or non-continuous welds, nor can it be used in cramped, closed areas.

8. It was for this purpose that two types of universal semi-automatic welding machines, the PSh-5 and PDSh-500, were designed. In these machines a bar electrode wire, 2 mm, in diameter, is fed through the wire-hose into the area of the welding arc which is burning under a flux coat. Therefore, the new method was designated "hose type, semi-automatic welding under a flux coat."

9. These apparatuses are outstanding for their simplicity of construction and small bulk. They considerably facilitate the work of the welder.

10. The hose-type, semi-automatic machine has the following basic components:

The feed point (1) which consists of a welding transformer and a choking coil /DROSSEL'/ on a no-load voltage /NAPRAZhNENIE KhOLOSTOGO KhODA/ of not less than 60 volts, or else a direct-current generator. A portable machine case (2) with a switch gear /RASPREDELITEL'NOE USTROJSTVO/, portable feed mechanism (3) with a hose /ShLANG/ (4) and a holder /DERZhATEL'/ (5). The feed mechanism feeds electrode wire at a constant speed into a special hose conductor (4) from the spool /KASSETA/ and thence into the zone of the arc. The feed mechanism is actuated by an asynchronous electric motor with a power of 0.1 KVT /Kilowatts/. Change in the speed of electode-wire feeding is attained by change gears /SMENNEY ShESTERNI/. In some instances the feed mechanism is suspended over the welder's working area. A special flexible hose conductor, 3.5 meters in length, serves to conduct current to the nozzle /MUNDShTUK/ and to feed the electrode wire. The holder (5) consists of a nozzle /MUNKShTUK/ with a hand-operated funnel for flux, and a starting button. The tip of the nozzle /NAKONECHNIK MUNDShTUKA/ is a replaceable part as it is subject to the greatest wear and tear.



a - DR [choke coil]

b - ST [grid transformer]

11. The semi-automatic PSh-5 is intended for welding with wire 2 mm in diameter and with currents up to 650 A /amperes/. The speed of wire-feeding can be changed by means of a change gear assembly /NABOP SMENNYKh ShESTEREN/.

12. In the hose-type, semi-automatic PDSh-500, not only the electrode wire, but also the flux, is fed into the flexible hose. For this purpose, the PDSh-500 apparatus has a special mechanism for pneumatic flux-feeding and a filter water, oil and other admixtures from air fed from the plant system.

13. The following types of welds can be welded using hose-type semi-automatic welding under a flux coat: butt, fillet /VALIKOVYJ/ (angle), continuous /SPLOShNOJ/ and non-continuous /PRERYVISTYJ/, straight-line /PRYaMOLINEJNYJ/ broken-line /LOMANYJ/ curved /KRIVOLINEJNYJ/ and circumferential, inclined at an angle up to 20 degrees from the horizontal. Hose-type, semi-automatic welders can also be used for stepped welding /SVARKA STUPENChATYMI SPOSOBAMI/ for making seams in repair jobs and for repairing defective output in foundry production.

14. The complete mobility of the semi-automatic welder makes it possible to weld in places not easily accessible to automatic welders of the open or closed-arc-type, and to service larger production areas by moving the feed mechanisim.

15. At present the following jobs are performed by hose-type semi-automatic welders in ship-repair and ship-building yards:

(a) Welding collars /POYaSOK/ to brackets /KNITSA/ or to joint connections of substructures /UZEL FUNDAMENTOV/ using continuous /SPLOShNOJ/ as well as non-continuous /PRERYVISTYJ/ welds.

(b) Welding longitudinal and lateral strengthening ribs /REBRO ZhESTKOSTI/ to floor plates /FLOR/ and stringers.

(c) Welding short butt joints /STYKOVYE SOEDINENIE/ on joint connections /UZEL/ and assemblies /KOMPLEKT/.

(d) Welding longitudinal and lateral assemblies to flat sub-sections by continuous /SPLOShNYJ/ and non-continuous /PRERYVISTYJ/ welds (as much as 40 to 45% of the total volume of welding work.

(e) Welding substructure joint connections of various types to flat-section surfaces /POLOTNIShchE PLOSKOSTNYKh SEKTsIJ/. This includes welding platform decking /NASTILY PLATFORM/ and decks to the external plating of the hull, welding substructures to the covering /NASTIL/ of the double bottom of the deck, and welding longitudinal and lateral bulkheads to the deck covering /NASTILY PALUBY/, (which amounts to as much as 15-20% of the total volume of welding work).

16. A special flux, make AN-348, was developed in 1948 for hose-type semi-automatic welding. Its composition, expressed in per cents, follows:

SiO_2 - 42-45%

CuO 6.0-9.0%

$CuFe_2$ 6-7.5%

Mno 32-35%

MgO 0.5-0.3%

Na_2O 1.0-1.5%

There must be no more than 4% of admixtures in the flux.

17. AN-348 flux has the following properties:

(a) It raises the stability of the arc and therefore can be charged from ordinary transformers with no-load voltages /NAPRYaZhNENIE KhOLOSTOGO KhODA/ of 60 to 65 volts.

(b) It is equally suited for welding on both direct and alternating current.

(c) It gives off a very insignificant amount of harmful gases.

18. When using hose-type semi-automatic welding, the following is recommended.

(a) For steel of a particular thickness on experimental models, the optimum welding regime (strength of current, voltage and speed) should be selected which will result in the best formation of the weld, depending upon the type of joint /SOEDINENIE/, during butt or fillet /VALLKOVYJ/ seam welding.

(b) The area to be welded should be carefully cleaned, special attention being paid to the cleaning of sheets which are to be lap-welded.

(c) Edge-grooving /RAZDELKA KROMOK/ of the basic metal should be carried out only to make space for the surpluses of molten electrode metal. In most cases butt welds may be welded without grooving the edges /BEZ RAZDELKI KROMOK/.

(d) A bare low-carbon wire (from which rust, oil, etc, have been removed), 2mm in diameter, should be used for welding low-carbon steel (carbon up to 0,27%).

(e) Preferably, finely-crushed flux should be used.

19. In semi-automatic, hose-type welding, it is the welder directly, who controls the speed of the motion of the electrode holder and who keeps the nozzle which directs the flux at a definite distance above the surface of the weld. Therefore, preliminary training in butt-welding and fillet /VALIKOVYJ/ welding is essential in order to acquire the requisite habit-patterns for maintaining the speed and the interval required. Usually the welder of average skill acquires such habit patterns in two or three days.

20. Semi-automatic hose-type welding has greatly increased the efficiency of welding jobs and has reduced the labor required to 40% per linear meter of seam to be welded.

21. PSh-5 semi-automatic hose-type welders are produced by the Institute of Electric-Welding, Academy of Sciences of the Ukrainian SSR.

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